

over the continent, descending here and there to the earth's surface. All that portion of the continent that is under the influence of this descending wind is subject to dry, warm föhn winds, and, at the best, relatively light rains. If the lower current on the windward side of the range is relatively feeble and but little rain is deposited on the windward side, then but little wind will flow thence over the continent, the volume of the descending dry föhn winds will diminish, and the chances for local rains in the interior will increase.

In general, the quantity and frequency of rain depends upon the heights of clouds whose very formation itself depends upon the upper and lower winds. The absolute quantity of rain depends, also, upon the dew-point, and, other things being equal, is, therefore, greater for moist winds than for dry; but the relative quantity and the relative frequency of rain in successive seasons are the features that determine a drought, in ordinary agricultural usage, for any locality, and these depend essentially upon the relative movements of the atmosphere in the respective seasons. If the movements are downward, or feebly upward, or if they introduce cooler or drier air than usual, the result is drought; if they are more strongly upward than usual, they bring cloud and rain. These principles are abundantly illustrated by the winds and rains that prevail in the interior of India, Australia, and North America.

WATER MEASUREMENTS FOR IRRIGATION.

The attention of the Editor has been called to the fact that on page 209 of the MONTHLY WEATHER REVIEW for May, 1897, he has adopted the British Imperial gallon, which is used in many parts of this country, and has said nothing about the British wine gallon, which is also used. The imperial gallon contains 10 pounds of water, or 277.274 cubic inches. The wine gallon contains 8.3389 pounds of water, or 231 cubic inches. Records expressed in imperial gallons may be converted into wine gallons by multiplying them by the factor 10/8.3389 or 1.21.

CHINOOKS IN IOWA.

If the term "föhn wind" is to be used as a general name for all warm, dry, descending winds then, of course, there may be a similar propriety in the use of the word "chinook," but as "föhn" has the priority of many years of meteorological usage, and as we have both dry chinooks in Montana, and wet chinooks in Oregon and Washington, the Editor would prefer the unambiguous Swiss or Helvetian word "föhn."

The Climate and Crop Report from Iowa for the month of December contains two interesting notes by observers. At Clarinda, A. S. Van Sandt says:

On the morning of the 29th the wind was in the northwest, soon veering to west. It was as mild as May and reminded me of what I have read of the chinook. Query: Was it the tail end of one? The snow, which was very compact from previous melting, lost one-third of its depth.

At Odebolt, E. Starnes says:

December 4.—Chinook at midnight that settled the snow about 6 inches.

Before studying the weather maps to ascertain whether conditions were favorable for descending winds on these dates, the Editor would say that, in general, such winds may occur at any spot on the globe. The fact that they are peculiarly frequent and effective in certain regions, such as Switzerland, Greenland, western Montana, New Zealand, and northern India should not prevent us from recognizing the fact that they are recurring frequently in almost every other region. Whenever some air ascends other air must descend. There can be no doubt but that the famous hot winds that occur occasionally from Texas northward to Canada are descending

winds.* It is scarcely proper to speak of the föhn wind in Iowa as the tail end of a chinook that had spread from Montana down to that State, because both these terms are generally more restricted in extent. The hot winds of Iowa and of Montana are generally separate local chinooks.

On examining the weather maps for December 4 and 29, we find that on the morning of the 4th the temperature had risen remarkably in western Nebraska, eastern Wyoming, and northward through Dakota and Montana into Canada. The winds were from the southwest, the air was descending the eastern Rocky Mountain Slope, the pressure was 30.70 over the region around Salt Lake City, and 29.70, or less in Manitoba, everything was favorable for a chinook in the intermediate regions. By the 5th, a. m., the warm winds had covered a large region southeastward to the Mississippi Valley. Evidently the whole mass of air flowing eastward from the region of high pressure was descending along the surface of the ground and did not begin to rise until it came within the influence of the low pressure near the Lake Region. On the 4th, a. m., at Havre, Mont., the temperature was 56° higher than on the 3d, a. m. This was an intense chinook. Iowa had temperatures 12° or 14° higher, and during the whole day experienced a moderate chinook. All the intermediate regions had their descending dry and relatively warm winds.

On December 29 the conditions were very similar. The high pressure was over the Salt Lake region; the lowest pressure was over Lake Superior; the whole eastern Rocky Mountain Slope was covered with a layer of descending air, clear and dry, and, in general, warmer to such an extent that Iowa, Minnesota, and Wisconsin were from 20° to 50° warmer than on the 28th. The chinook—if it may be so called—prevailed from the Rocky Mountains eastward to the Mississippi. Iowa did not get the tail end of it but was in the midst of it.

If "chinook" and "föhn" are terms that are to be restricted to intense local manifestations of descending winds, and if by the "hot winds" of the western plains we designate only those that occur at the time of the ripening of the wheat and corn, when they do such injury to crops, then we ought perhaps to devise some term specifically appropriate to these widespread areas of descending winds that bring dry, clear, warm weather to one-half of the Mississippi watershed.

Not only does the eastern slope of the Rocky Mountain region have its descending chinook winds, but so also has the eastern slope of the Appalachian range, a fact that was pointed out by the Editor as long ago as 1872. The westerly winds that bring fog and possibly rain or snow to Buffalo, Pittsburg, Knoxville, and Chattanooga frequently descend upon New York, Washington, Lynchburg, Columbia, S. C., and Atlanta as clear dry winds, and on the average a very little warmer than on the windward side of the mountain range. One of the first indications of this action of descending winds was observed soon after the station at Lynchburg was opened in 1871, when it was found that so-called clearing up weather and the first clear sky began at that station some hours before it reached Washington, and even a whole day earlier in the case of very slowly moving changes.

An area of high pressure apparently represents a region in which air is descending so slowly to the earth's surface that it cools by radiation faster than it warms up by compression. When such an area is central, as occurred so frequently during December, over the middle Plateau Region, the atmosphere is pushed not merely eastward down the eastern slope, but also northwestward into California, Oregon, and Washington. It is the relatively rapid descent down these slopes that causes the air, which is compressed by its own

*See the article "Summer Hot Winds on the Plains," by Dr. I. M. Cline, Weather Bureau Observer, in the Bull. Phil. Soc. Washington, XII, 1894.